

**AIR RESOURCES BOARD
EQUIPMENT AND PROCESS PRECERTIFICATION EVALUATION
July 1, 1998**

PERFORMANCE PRECERTIFICATION:

Applicant: **Fulton Boiler Works, Incorporated**
3981 Port Street, Box 257
Pulaski, New York 13142-0257

Application No.: 96018
Executive Order: G-96-029-013

Model Numbers: **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE**

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GENERAL INFORMATION:

1. Program Background and Applicant Request

The Equipment and Process Precertification Program (Program) is a voluntary statewide program for manufacturers of commonly-used equipment which emit air pollutants. This program is designed to assist local air pollution control and air quality management districts (Districts) in their efforts to streamline the air pollution permit process. On June 14, 1996, the Air Resources Board (ARB) adopted section 91400 of the California Code of Regulations which incorporates the Criteria for Equipment and Process Precertification (Criteria). The regulation and Criteria were approved by the California Office of Administrative Law on October 31, 1996 and became effective on November 30, 1996.

This evaluation is designed to verify performance claims made by manufacturers with regard to specific equipment models. Performance claims are made by the applicants in the Scope of the Precertification as part of the application package. All manufacturer claims must be supported through verification testing and validated by ARB staff review.

Fulton Boiler Works, Incorporated (Fulton), requested performance verification precertification under the ARB Equipment and Process Precertification Pilot Program for the **Fulton 60 BHP** natural gas water boiler (model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE.**)

2. Equipment/ Process Description:

Type of Equipment:	natural gas-fired water boiler
Description Process:	provides hot water for industrial and commercial applications Fuel: Public Utility Commission (PUC) quality natural gas
Boiler Heat Output:	60 horsepower (BHP)
Model Numbers:	ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE
Heat Input:	2,520,000 British Thermal Units per hour (BTU/hr)

3. Air Pollution Control Equipment:

The **Fulton 60 BHP** boiler (model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE**) consists of a burner that utilizes a premix design which combines fuel and air prior to the ignition point. The premix gas then flows at an increased flow velocity through the flame zone which decreases the residence time of reactants within the flame zone, reducing the emissions.

SUMMARY OF THE SCOPE:

The applicant seeks performance precertification for the **Fulton 60 BHP** water boiler model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE** for the following standards:

1. Oxides of nitrogen (NO_x) less than 25 parts per million by volume, measured on a dry basis (ppmdv), corrected to 3 percent oxygen (O₂)
2. NO_x less than 20 nanograms per Joule (ng/J) or .05 pounds per million British thermal units (lb/ MM BTU)
3. Carbon monoxide (CO) less than 50 ppmv, corrected to 3 percent O₂

APPLICABLE STATE AND FEDERAL REQUIREMENTS:

There are no applicable State and federal air pollution regulations for boilers of this size.

EMISSIONS:

The emission estimate for NO_x is based on using the precertification concentration value of 25 ppmv, corrected to 3 percent O₂ as a limit. This assumes that all NO_x formed is in the form of NO₂. Similarly, the emission estimate for CO is based on using the precertification concentration value of 50 ppmv, corrected to 3 percent O₂ as a limit.

Pollutant	Emission Factor	Potential to Emit
NO ₂	30.3 lb/MM dscf	7.64 E-2 lb NO_x/hr
CO	36.9 lb/MM dscf	9.30 E-2 lb CO/hr

Emissions for the other criteria pollutants- sulfur dioxide (SO₂), volatile organic compounds (VOC) and particulate matter (PM), have been estimated using the United States Environmental Protection Agency (U.S. EPA) AP-42, Section 1.4 for commercial boilers (.3-<10 MM BTU) with low NO_x burners (Revised January 1995) and maximum heat input of **2,520,000 BTU/hr**. These emissions have not been verified by emissions testing, but are provided for informational purposes for Districts.

Pollutant	Emission Factor	Potential to Emit
SO ₂	.6 lb/MM dscf	1.51 E-03 lb/hr
VOC	5.28 lb/MM dscf	1.33 E-02 lb/hr
PM	12 lb/MM dscf	3.02 E-02 lb/hr

Emissions of formaldehyde (HCHO) have been estimated using U.S. EPA- 450 / 2-90-011, Toxic Air Pollutant Emission Factors - A Compilation for Selected Air Toxic Compounds and Sources, Second Edition (October 1990) for commercial natural gas combustion. These emissions have not been verified by emissions testing, but are provided for informational purposes for Districts.

Pollutant	Emission Factor	Potential to Emit
HCHO	.2203 lb/MM dscf	5.55 E-04 lb/hr

EVALUATION OF TEST REPORT:

Verification testing was conducted by an independent testing laboratory, California Compliance Services (CCS), and the tests were performed on two Fulton boilers located at Jet Propulsion Laboratories, Pasadena, California. These Fulton boilers tested have the same configuration as the models for which Fulton is seeking certification. The testing protocol was followed in accordance with South Coast Air Quality Management District (SCAQMD) Rule 1146.1: Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (revised 5/13/94) using SCAQMD Method 100.1.

The test report evaluation was conducted by ARB staff. It is the recommendation of the ARB that the **Fulton 60 BHP** water boiler (model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE**) be precertified as meeting the standard of less than 25 ppmv of NO_x, 50 ppmv of CO, both pollutants corrected to 3 percent oxygen. The air-fuel ratio is fixed for each boiler. The **Fulton 60 BHP** water boiler (model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE**) is also precertified as meeting the NO_x standard of less than .05 lb/MM BTU (20 ng/J).

CONCLUSIONS:

The test data, scope, and application were submitted by Fulton for precertification consideration. The test data were reviewed by ARB staff and found to meet the data quality objectives outlined in the scope for NO_x and CO. The ARB has reviewed this information along with applicable State and federal air pollution rules and concludes that this boiler is exempt from current State and federal rules. However, local District rules may be applicable in some regions. The applicable local Districts were forwarded a copy of the precertification evaluation for review and comments.

RECOMMENDATIONS:

The California Compliance Services test data was found to support the claims made by Fulton regarding the **Fulton 60 BHP** water boiler (model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE**). The test data verified that the boiler would meet 25 ppm_{dv} NO_x, 50 ppm_{dv} of CO, both corrected to 3 percent O₂. Therefore, the ARB staff recommends precertification under the Equipment Precertification Pilot Program of the **60 BHP** water boiler (model numbers **ICS 60-LE; ICW 60-LE; FB-060-A-LE; FB-60-F-LE; and ICX 60-LE**) to the levels stated above.

PRECERTIFICATION CONDITIONS:

1. Precertification does not relieve the person constructing, installing or operating the equipment at each specific site from the requirement to obtain an authority to construct and permit to operate. Precertification does not relieve a person from compliance with any local air rule or regulation.
2. Any manufacturer's modification that affects the performance or emissions of this boiler shall void this precertification. This precertification is valid only for the equipment designed and tested for this evaluation.

RECOMMENDED OPERATING CONDITIONS:

1. This equipment shall be properly operated and maintained in accordance with manufacturer's recommended operating and maintenance instructions. This equipment shall be properly maintained and kept in good operating condition at all times. This includes cleaning the burner assembly every six months and keeping the equipment in good operating conditions at all times.
2. This boiler shall be fired with PUC quality natural gas only.

APPENDIX A

CALCULATIONS

1. ESTIMATED EMISSIONS FOR PRECERTIFIED POLLUTANTS:

Precertification standards for NO_x and CO have been identified in the scope of the precertification. The emission factor in pounds (lbs) per MMBTU was determined using the threshold value of 25 ppm_{dv} of NO₂ for NO_x, and 50 ppm_{dv} of CO, both corrected to 3 percent oxygen (% O₂), as specified in the scope by the applicant.

This emission factor was determined using 40 CFR Method 19, Section 2.1. The emission rate can be determined from:

$$E = C_d F_d [20.9 / (20.9 - \% O_{2d})]$$

E = emission rate (lb/ MM dscf)
C_d = concentration in lb/ dry standard cubic feet (dscf)
F_d = F Factor for natural gas = 8710 dscf /MM BTU
O_{2d} = 3 (concentration is corrected to 3%)

First, convert the concentration

$$C_d = C_{mf} X M$$

C_d = concentration in lb/dscf
C_{mf} = mole fraction
X = molecular weight
M = conversion factor of 1 lb mole of combustion gas to dscf at an absolute pressure of 14.7 psia and a temperature of 68 F.
= 1 lb mole / 385.4 dscf

Using the above equation the NO₂ emission estimate is:

$$C_d = (25 \text{ E-06}) (46 \text{ lb NO}_2 / 1 \text{ lb mole NO}_2) (1 \text{ lb mole} / 385.4 \text{ dscf})$$
$$C_d = 2.98 \text{ E-6 lb/dscf}$$

Then substituting values into the emission rate equation:

$$E = (2.98 \text{ E-6 lb/dscf}) (8710 \text{ dscf} / \text{MM BTU}) (20.9 / 17.9) (1000 \text{ BTU} / \text{dscf})$$
$$E = 30.3 \text{ lb NO}_2 / \text{MM dscf}$$

The NO₂ emissions per hour can be determined using the maximum heat input of the unit **(2,520,000 BTU/hr)** [For natural gas 1 dscf = 1000 BTU]. The potential to emit was determined using:

$$PE = EH$$

PE = estimated potential to emit

E= emission factor

H= heat input

$$PE_{NO_2} = (30.3 \text{ lb NO}_2 / \text{MMdscf}) (1 \text{ dscf} / 1000 \text{ BTU}) (2,520,000 \text{ BTU} / \text{hr}) \\ = 7.64 \text{ E-2 lb NO}_2 / \text{hr}$$

Similarly, CO emission calculations:

$$C_d = (50 \text{ E-06}) (28 \text{ lb CO} / 1 \text{ lb mole CO}) (1 \text{ lb mole} / 385.4 \text{ dscf}) \\ C_d = 3.63 \text{ E-6 lb/dscf}$$

Then substituting values into the emission rate equation:

$$E = (3.63 \text{ E-6 lb/dscf}) (8710 \text{ dscf} / \text{MM BTU}) (20.9 / 17.9) (1000 \text{ BTU} / \text{dscf}) \\ E = 36.9 \text{ lb CO} / \text{MM dscf}$$

$$PE_{CO} = (36.9 \text{ lb CO} / \text{MMdscf}) (1 \text{ dscf} / 1000 \text{ BTU}) (2,520,000 \text{ BTU/hr}) \\ = 9.30 \text{ E-2 lb CO/hr}$$

2. ESTIMATED EMISSIONS FOR THE OTHER CRITERIA POLLUTANTS:

For the other pollutants, emissions were estimated using AP-42 Section 1.4 emission factors and the potential to emit equation above. The maximum heat input of the unit is **2,520,000 BTU/hr** [For natural gas 1 dscf = 1000 BTU]. The resulting emission estimates are:

$$\text{SO}_2 \text{ emission factor} = .6 \text{ lb} / \text{MMdscf} \\ \text{SO}_2 = (.6 \text{ lb/MMdscf}) (1 \text{ dscf} / 1000 \text{ BTU}) (2,520,000 \text{ BTU/hr}) = 1.51 \text{ E-03 lb /hr}$$

$$\text{VOC emission factor} = (1-.34) \times 8.0 \text{ lb/MMdscf} = 5.28 \text{ lb/MMdscf} \\ \text{VOC} = (5.28 \text{ lb/MMdscf}) (1 \text{ dscf} / 1000 \text{ BTU}) (2,520,000 \text{ BTU/hr}) = 1.33 \text{ E-02 lb /hr}$$

$$\text{PM(total) emission factor} = \text{PM (filterable)} + \text{PM (condensable)} \\ = 4.5 \text{ lb/MMdscf} + 7.5 \text{ lb/MMdscf} = 12 \text{ lb} / \text{MM dscf} \\ \text{PM} = (12 \text{ lb/MMdscf}) (1 \text{ dscf} / 1000 \text{ BTU}) (2,520,000 \text{ BTU/hr}) = 3.02 \text{ E-02 lb /hr}$$

" methane comprises 34 percent of the total organic compounds

3. ESTIMATED EMISSIONS OF FORMALDEHYDE:

For formaldehyde, emissions were estimated using U.S. EPA- 450 / 2-90-011, Toxic Air Pollutant Emission Factors - A Compilation for Selected Air Toxic Compounds and Sources, Second Edition (October 1990) for commercial natural gas combustion.

$$\text{HCHO emission factor} = 220.3 \text{ lb} / 10 \text{ E12 BTU} \\ \text{HCHO} = (220.3 \text{ lb} / 10 \text{ E12 BTU}) (2,520,000 \text{ BTU/hr}) = 5.55 \text{ E-04 lb /hr}$$

4. Correction from measured test data of NO_x to 3% O₂:

$$[\text{NO}_x] @ 3\% \text{ O}_2 = [\text{NO}_x] @ \text{actual \% O}_2 (21 - 3) / (21 - \text{actual \% O}_2)$$

boiler number	O ₂ % measured	NO _x ppmdv measured	NO _x ppmdv corr. to 3% O ₂
1	6.92	10.53	13.48
2	7.48	8.24	10.99
		avg=	12.24

5. Correction from measured test data of CO to 3% O₂:

$$[\text{CO}] @ 3\% \text{ O}_2 = [\text{CO}] @ \text{actual \% O}_2 (21 - 3) / (21 - \text{actual \% O}_2)$$

boiler number	O ₂ % measured	CO ppmdv measured	CO ppmdv corr. to 3% O ₂
1	6.92	ND < 1	ND < 1
2	7.48	.15	.20
		avg=	< 1

6. CONVERSION FROM CONCENTRATION MEASURED TO EMISSION RATE:

Again using the concentration equation C_d from section 1 of this Appendix, the mean concentration of NO_x can be converted to an emission rate in lbs/ MM BTU.

$$\begin{aligned} C_d &= (12.24 \text{ E-06}) (46 \text{ lb NO}_2 / 1 \text{ lb mole NO}_2) (1 \text{ lb mole} / 385.4 \text{ dscf}) \\ C_d &= 1.46 \text{ E-6 lb/dscf} \end{aligned}$$

Then converting from dry standard cubic feet to MM BTU using the F factor for natural gas (where the dry combustion from natural gas combustion equals 8710 dscf/ MM BTU):

$$\begin{aligned} E &= (1.46 \text{ E-6 lb/dscf}) (8710 \text{ dscf} / \text{MM BTU}) \\ E &= 1.27 \text{ E-02 lb NO}_2 / \text{MM BTU} \end{aligned}$$

Then converting lbs to grams and BTU to joules the emission rate becomes:

$$\begin{aligned} E &= (1.27 \text{ E-02 lb NO}_2 / \text{MM BTU}) (\text{BTU} / 1055 \text{ J}) (454 \text{ g} / \text{lb}) \\ E &= 5.47 \text{ ng} / \text{J} \end{aligned}$$